Information Technology

ocp

InFrameSynapse Scheduler

Advanced Planning & Scheduling with the InFrame Synapse Scheduler Solution

Application Areas

Product

InFrame Synapse Scheduling Software enables a smooth planning and allocation of manufacturing resources considering all essential restrictions (hard constrains) from the shop floor. Therefore, a minimization of costs and an improvement of manufacturing efficiency is realized.

Application Areas

- Release / Demand Planning
  - Product mix and lot start planning
  - Due date planning and inventory forecasting
  - Resource utilization forecasting
- Human Resource Planning
  - Optimal allocation of operators to processing tasks, maintenance activities consideration of skill groups, shifts, holidays and work calendars
- Maintenance Scheduling
  - Allocation and scheduling of maintenance tasks consideration of resource utilization, especially temporary bottleneck situations
- Online Scheduling and Dispatching
  - Ad-hoc dispatching and re-scheduling based on unforeseen events (down events)

Planning Horizons and Required Level of Detail

Level of Detail of Shop Floor Parameters

Short-term Planning

Hourly or daily planning for next shift, detailed resource scheduling, sequence determination for dispatching

Planning horizon: now to **several days** in advance

Consideration of …
- all manufacturing related constraints
- all resources linked to the manufacturing process
- detailed shift calendars

Mid-term Planning

Weekly planning of manufacturing orders, order scheduling and maintenance planning

Planning horizon: now to **several weeks** in advance

Consideration of …
- primary and secondary manufacturing resources
- operator and resource availabilities

Long-term Planning

Monthly planning of production program, product mix, multi-plant planning

Planning horizon: now to **several months** in advance

Consideration of …
- order planning across several manufacturing plants
- product mix scenarios

Length of Planning Horizon

System Functionality and Customer Benefits

System Functionality

The InFrame Synapse Scheduling Solution generates optimum resource schedules with consideration of:

- Earliest release date & due data
- Multi-resource planning
- Sequence dependent setups & interoperation times
- Resource availabilities & work calendars
- Split & merge steps
- Resource library with specific timing models: single unit, parallel batch, sequential batch, lot based, tact, assembly operation
- Customer specific user interfaces and reports
- What-if analysis and management of planning scenarios

Customer Benefits

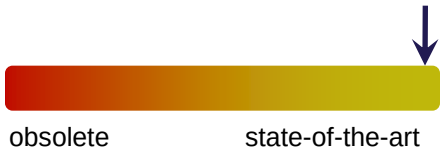
- ✓ Maximization of on-time delivery performance
- ✓ Shortening of product cycle times
- ✓ Maximization of throughput
- ✓ Reduction of inventory (work in process)
- ✓ Maximization of the utilization of critical resources
- ✓ Minimization of labor costs
- ✓ Identification and management of bottlenecks in the factory

Comparison of InFrame Synapse Scheduler with other Advanced Planning & Scheduling Software Systems

- **License Costs**
  - + small integration effort, small training effort
  - + floating license model

- **Functionality & Scheduling Features**
  - + flexible timing and resource models
  - + planning with finite capacity

- **Scope of Planning & Application**
  - + short-term and medium-term planning, production program planning, multi-plant planning
  - + multi-resource planning, operator shift planning



- **Software Technology & Scalability**
  - + client-server, J2EE, scalable platform, SOA

- **Calculation Performance**
  - + fast forward planning algorithm

Required Input Data for the InFrame Synapse Scheduler

Import/Update from ERP or Data Management in the InFrame Synapse Data Base

Order Data

- Order ID / Lot ID
- Lot Size
- Static Priority
- Due Date
- Earliest Release Date
- Reference to Product

Import/Update from Engineering / Shop Floor Control Systems or Data Management in the InFrame Synapse Data Base

Process Flow Data

- Product ID
- Process Step Data
  - Step Sequence
  - Process Time
  - Setup Time
  - Load-/Unload Time
  - Reference to Resources or Resource Groups (Machines, Operators, etc.)

Resource Data

- Resource Group ID
- Skill Matrix
- Resource Data
  - Resource ID
  - Capacity
  - Timing Model (Batch, Assembly, Tact, etc.)
  - Operator & Machine Availability (Calendar Entries)

Example Screenshots – Data Base Tables

Process Flow Data Table:

Operationplan : Tabelle

PlanID	Position	ProcessID	EquipmentGroupID	CostCenter	TOpR	TSeR	TLoE	TVpR	TUlE	TPrE	TPrR	TSpR	TFtR	TOcR	PanelPerPl	Recipe	TTaktP	1
10019.2A	1	Material rüsten		2000	0	10	0	0	0	0,5	0	0	0	0	1		0	
10019.2A	2	Cu-Reduzieren	Cu-Reduzieren	4500	0	1	0,1	0	0,1	10	0	10	0	0	1		0,5	
10019.2A	3	Filme bestellen																
10019.2A	4	Chem. Vorbehandlung	Vorbehandlung Micro-Etch Presserei															
10019.2A	5	Flüssigresist aufbringen	Flüssigresist Aufbringen															
10019.2A	6	Belichten	Fotoresist Belichten															
10019.2A	7	Entwickeln	Fotoresist Entwickeln Flex															
10019.2A	8	Ätzen	Ätzen Starr															
10019.2A	9	Strippen	Fotoresist Strippen Starr															
10019.2A	10	Visuelle Zwischenkontrolle																
10019.2A	11	Plasma Ätzen	Plasma															
10019.2A	12	Durchplattieren	Galvanik Starr															
10019.2A	13	Konturfräsen	Konturfräsen															
10019.2A	14	Nutzen-Nr prägen	Nutzen-Nr prägen															
10019.2A	15	Plasma/Via Kontrolle																
10019.2A	16	Kupfer Schichtdicke messen																
10019.2A	17	Kompensation bestimmen	Laser Bohren/Fräsen															
10019.2A	18	Filme bestellen																
10019.2A	19	Chem. Vorbehandlung	Vorbehandlung Micro-Etch Presserei															
10019.2A	20	Flüssigresist aufbringen	Flüssigresist Aufbringen															
10019.2A	21	Referenzsystem stanzen	Referenzsystem Stanzen Reinraum															
10019.2A	22	Belichten	Fotoresist Belichten															

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OperatorSkills_Kreuztabelle : Kreuztabellenabfrage

OperatorID	1	2	3	4	5	6	7	8	9	18	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	3
1003	N	N	N	N	N	N	N	N	S	S	S	S	S	S	S	S	S	S	N	S	S	S	S	S	N	N	
1004	N	N	N	N	N	N	N	N	N	N	N	N	P	P	N	N	P	N	N	N	N	N	N	N	N	N	
1005	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1013	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	S	N	N	N	P	N	P	N	N	
1017	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1021	N	N	N	P	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1026	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1029	N	N	N	N	N	N	N	N	N	S	N	N	N	N	N	N	N	P	P	P	S	N	N	S	N	N	
1032	N	N	N	N	N	N	N	N	N	S	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1033	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	
1042	S	S	N	N	S	S	S	N	N	S	N	N	N	N	N	N	N	N	N	N	N	N	N	S	S	N	S
1043	P	P	P	P	N	N	N	P	P	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	P	N	
1044	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1052	N	N	N	N	N	N	N	N	N	N	N	N	N	P	P	P	N	N	N	N	N	N	N	N	N	N	
1054	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1055	N	N	N	N	N	N	N	N	N	P	P	N	P	P	P	P	N	P	N	N	P	N	N	P	N	N	
1057	N	N	N	N	N	N	N	N	N	S	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1060	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	S	S	S	N	N	S	N	N	
1072	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	
1075	N	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1077	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	P	
1083	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	S	N	N	N	P	N	P	N	N	
1084	P	P	P	P	N	N	N	P	P	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	P	N	
1094	N	N	N	N	P	P	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1095	N	N	N	N	N	N	N	N	N	P	P	P	N	N	N	P	P	N	N	N	N	N	N	N	N	N	
1102	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1106	N	N	N	N	N	N	N	N	N	P	P	P	N	P	P	P	N	N	N	N	N	N	N	N	N	N	
1109	N	N	N	N	N	N	N	N	P	S	N	N	N	N	N	N	N	N	N	S	S	P	N	P	N	N	
1110	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	S	N	N	N	P	N	P	N	N	
1119	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	S	N	N	N	P	N	P	N	N	
1120	N	N	N	N	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	N	N	N	
1123	N	N	N	N	N	N	N	N	N	P	P	P	N	P	P	P	N	N	N	N	N	N	N	N	N	N	
1129	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
1134	N	N	N	N	N	N	N	N	P	N	N	N	N	N	N	N	N	S	N	N	N	N	P	N	N	N	

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Operator Skill Matrix Table:

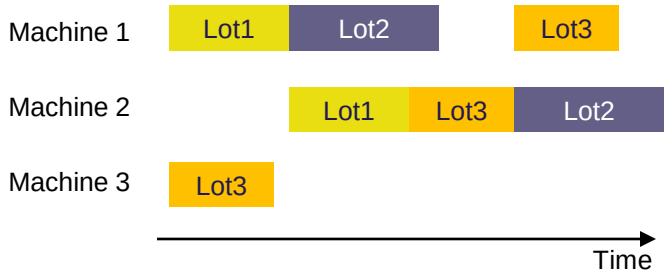
P: Primary Skill
S: Secondary Skill
N: None

Algorithm of the Scheduler Engine

InFrame Synapse Scheduler uses a very efficient forward planning algorithm for activity allocation.

- The algorithm is very fast and schedules activities in short calculation time*.
- Each created schedule is valid and executable on the shop floor. Generated schedules are optimized with regard to used defined manufacturing goals such as on time delivery performance, minimum make span, et cetera or a weighted combination of different goals.
- Deterministic algorithm which produces 100% repeatable results in case of using the same input and configuration data.

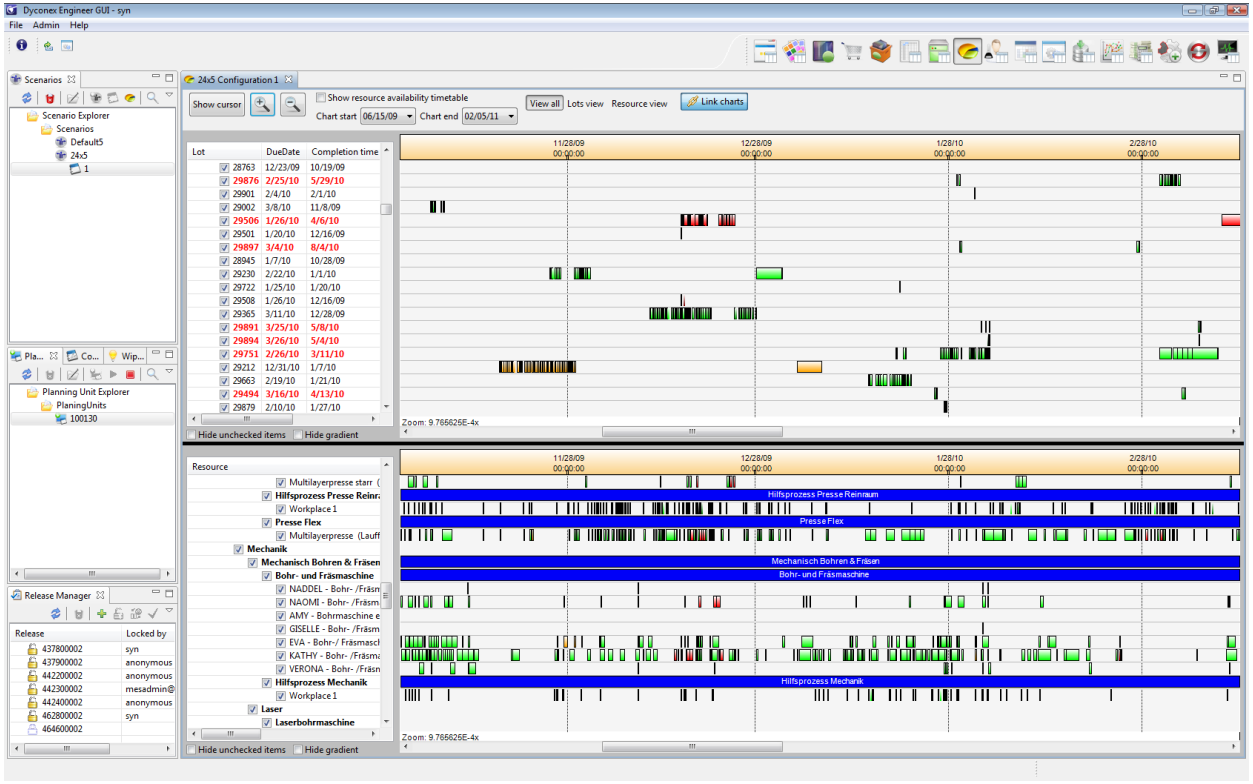
Example



* The calculation time is less than 1 minute for 150 000 activities to be scheduled when using a single CPU with 1,4 GHz (e. g. Pentium 4) and 512 MB RAM. This time can be reduced considerably when using a higher performance CPU.

Provided Output for Industrial Engineering, Shift Planning, Factory Control – Gantt Views

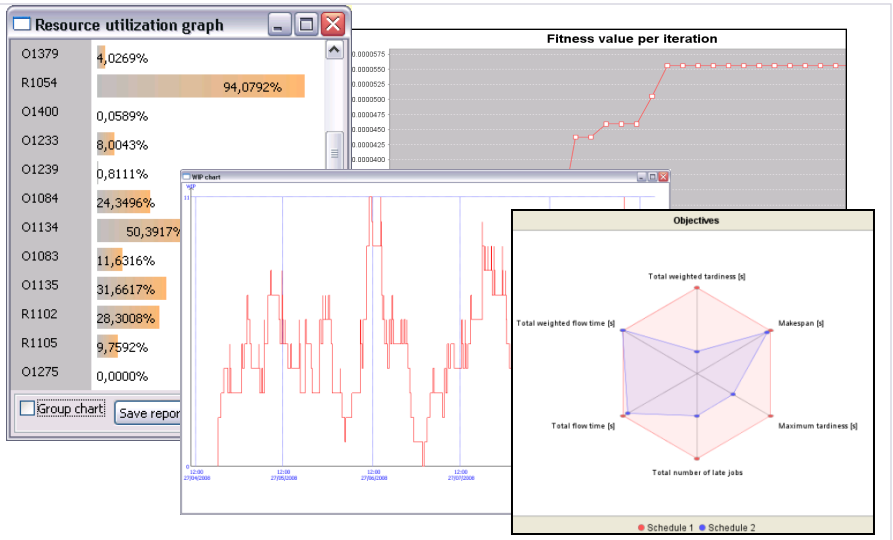
Gantt Chart (Resource und Lot View):



- Transparent view on all scheduled activities in a Gantt Chart
- Grouping of machines and operators in a resource tree with exand and collapse functionality
- Grouping based on manufacturing areas or equipment groups
- Product and lot tree view
- Tracking and highlighting of individual lots (filters)
- Loading and utilization visualization for each resource

Provided Output for Industrial Engineering, Shift Planning, Factory Control – KPI Charts and Reports

KPI Charts



- Graphical visualization of key performance indicators (KPI) – for example:
  - Utilization of resources
  - Inventory (WIP) timeline charts
  - Comparison of the fitness of different schedules in radar charts

Reports

Percentage of completed lots: 100,00%

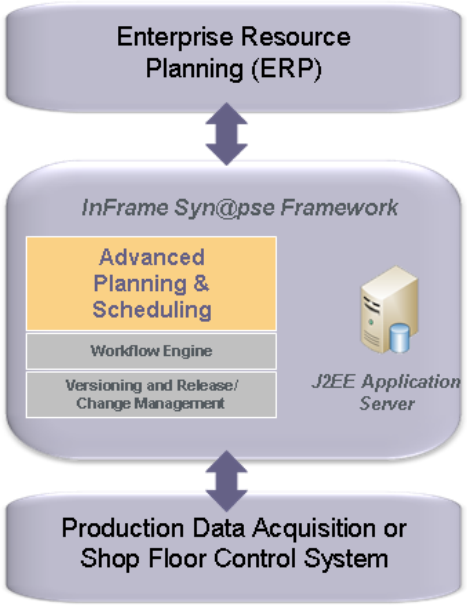
Lot	Start time	Finish time	Due date	LateLot	Cycle time (min)
L0000	07/01/2008 06:00	15/01/2008 18:52	07/02/2008 00:00	N	12292
L0001	08/01/2008 06:00	16/01/2008 14:00	11/02/2008 00:00	N	12000
L0002	08/01/2008 07:08	25/01/2008 16:24	21/02/2008 00:00	N	25036
L0003	08/01/2008 07:42	21/01/2008 16:24	12/02/2008 00:00	N	19242
L0004	08/01/2008 08:50	31/01/2008 16:24	22/02/2008 00:00	N	33574
L0005	08/01/2008 09:24	24/01/2008 20:48	13/02/2008 00:00	N	23724
L0006	09/01/2008 06:00	31/01/2008 10:48	21/02/2008 00:00	N	31968
L0007	09/01/2008 06:34	25/01/2008 08:24	14/02/2008 00:00	N	23150
L0008	09/01/2008 11:40	25/01/2008 16:24	28/02/2008 00:00	N	23324
L0009	09/01/2008 0				
L0010	09/01/2008 0				
L0011	10/01/2008 0				

Resource ID	Time Required (h)	Time Available (h)	Delta Time (h)
R1	6377,27	6360,00	-17,27
R11	3541,00	8480,00	4939,00
R12	3,95	4240,00	4236,05
R13	8636,50	21200,00	12563,50
R16	1056,13	16960,00	15903,87
R17	4239,07	12720,00	8480,93
R18	3974,08	8480,00	4505,92
R19	917,10	4240,00	3322,90
R2	438,40	6360,00	5921,60

- Tabulated output in GUI Tables
- File based output of KPI metrics as
  - text file
  - MS Excel file
  - et cetera

Integration in IT Landscapes - Examples

Single Site Integration

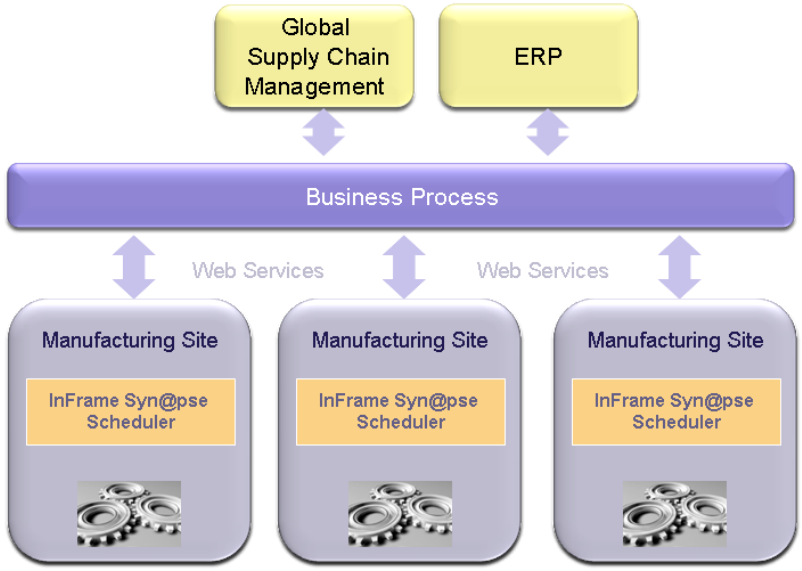


InFrame Synapse Scheduler is based on industrial standards such as J2EE and the InFrame Synapse Framework.

➔high scalability

➔easy integration with ERP and Shop Floor Control (MES) systems using open communication standards

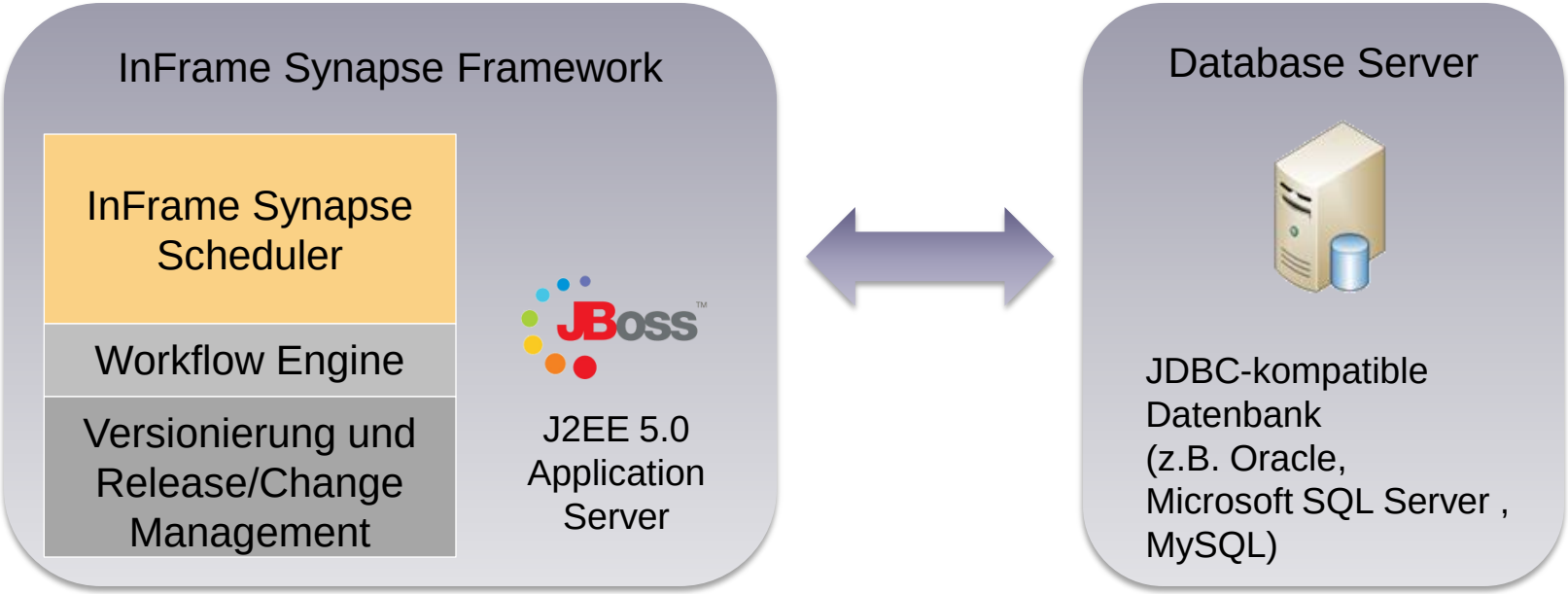
Multi Site Integration



The InFrame Synapse Scheduler supports a seamless integration into business process logic using service oriented architectures (SOA).

Architecture

Architecture Overview at one site:



Thank you for your attention.

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